

Design for "the pop-out effect in visual attention" experiment

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Background:

How we acquire impressions of complex objects is an open question. On the one hand, the Gestalt streaming assumes that sub-components are recognised only after an initial recognition of the corresponding superordinate entity. On the other hand, associationists suggest that a complex impression is inherently built upon a combination of elementary sensations. The feature-integration theory of attention (FIT) is part of the latter one. It postulates that features such as orientation, brightness and colour are processed automatically, fast and in parallel to be arranged in separate spatial representations. Focal attention then acts as glue to bind features of different type to a unitary object based on their spatial overlap.

Visual search is an experimental paradigm in which different entities (usually letters) are presented on a screen. The participant has to report as fast and as accurate as possible if a specific entity called target is displayed (positive trial) or not (negative trial). The target is defined by special features e.g. is of colour. The remaining objects are called distractors and the number of displayed entities is called display size. If no target is displayed The FIT claims that the detection of a target which is defined by only one feature (e.g. colour) requires no focal attention, as it suffices to scan along the corresponding feature representation. This enables the search to take place in parallel over multiple objects. On the contrary, the detection of a target that is defined by multiple features (e.g. colour and shape) requires focal attention to bind the different feature representations. This causes the search to occur serial as focal attention is not able to operate in parallel.

Indeed, visual search experiments (Treisman et. Al, 1977) suggest that search time for single target features is independent of display size, whereas search time for conjuncted target features increase linearly with display size. This difference is seen as evidence for the involvement of an additional serial processing step (focal attention) in the latter case.

Hypotheses:

We are going to address the following research hypotheses:

1. Visual search in the conjunction condition is serial and self-terminating.
 - a. In the conjunction condition, search time increases linearly with display size.
 - b. In the conjunction condition, the slope for negative trials is significantly larger than for positive trials.
2. Visual search in the feature condition is parallel.
 - a. In the feature condition, search time does not increase linearly with display size for positive trials.
 - b. In the feature condition, search time increases linearly with display size for negative trials.
3. The search in the conjunction and the search in the feature condition only differ when the search field contains more than one item.
 - a. Search times for trials with display size 1 do not differ between conditions.
4. There is no systematic effect of display size on errors.

Stimulus:

We will create the stimulus material based on the description provided in the paper. The stimulus screen is a visual search field. The background colour will be white. We use 4 different display sizes consisting of 1, 5, 15 and 30 items. Each display size will have the same measurements. As distractors we use the letter 'T' in brown colour and the letter 'X' in green colour. Both distractors will be positioned randomly with a share of 50/50. As targets in the conjunction condition we use the letter 'T' in green colour, and in the disjunction condition we use the letter 'T' and 'X' in blue colour as well as the letter 'S' in brown and green colour. Each letter will be the same size.

Procedure:

The experiment will start with instructions on the task, followed by 6 blocks of the experimental task and finally a short demographic survey. Each block is exclusively part of the conjunction (C) or disjunction (D) condition and consists of 128 trials (16 positive and negative per display size). The block sequence is randomised as CDDCCD and DCCDDC. The sequence of trials within a block is randomised as well. The target description is given to the participant at the beginning of each block. A trial starts with a central fixation cross displayed for one second, followed by the search configuration. After response, the participant is shown his or her reaction time and the correctness of his or her response. Participants are instructed to respond as fast and accurate as possible. For reporting a positive trial they click the button 'J', for reporting a negative trial click the button 'F'. In

case of erroneous trials, the consecutive trial will be a dummy trial, meaning that no data is recorded for this trial. In addition the erroneous trial will be repeated later in the same block.